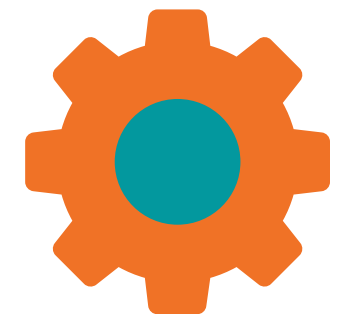




ENGINEERING

DAKOTA STEAM LEARNING FACILITATOR GUIDE (SHORT VERSIONS)



STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

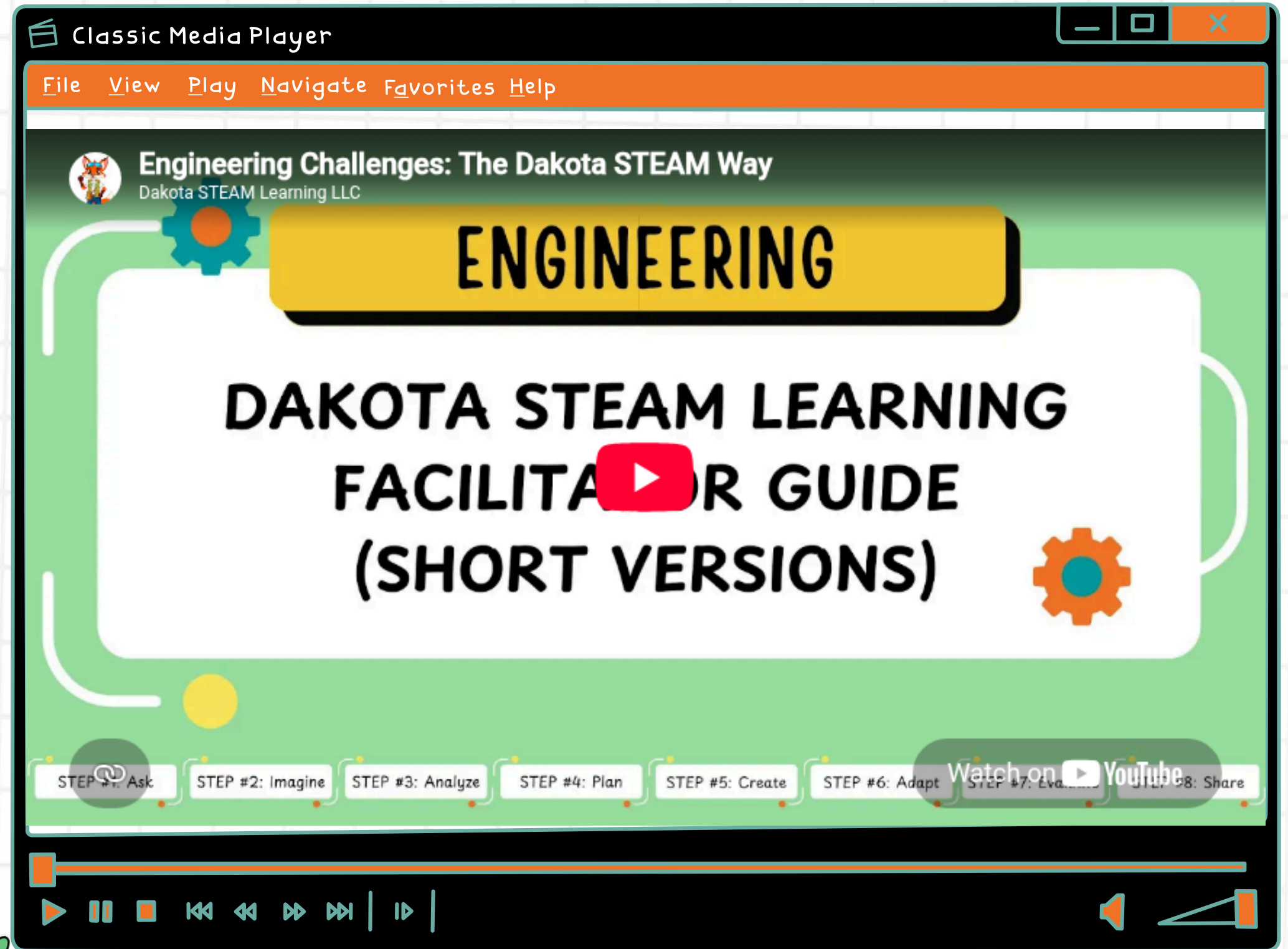
STEP #7: Evaluate

STEP #8: Share

Engineering STEAM Challenge

Facilitator Guide

Our Facilitator Guides give educators the clarity, confidence, and support needed to lead engaging STEAM experiences with purpose. Organized by topic, the guides provide a diverse range of meaningful content, with a strong emphasis on science and robust engineering and art strands. They also offer intentional opportunities to connect math, technology, and other STEAM elements in ways that help students see how learning works together across disciplines. This slide guide matches our products found on our website.



Use the resources embedded to watch a follow-along video version of this lesson.



Short Versions

Students only create one large solution to the problem.

We DO NOT ever recommend having students collaborate on an engineering project before they have first tried their own idea on their own.

Typically take 1.5-2 hours.



Full Versions

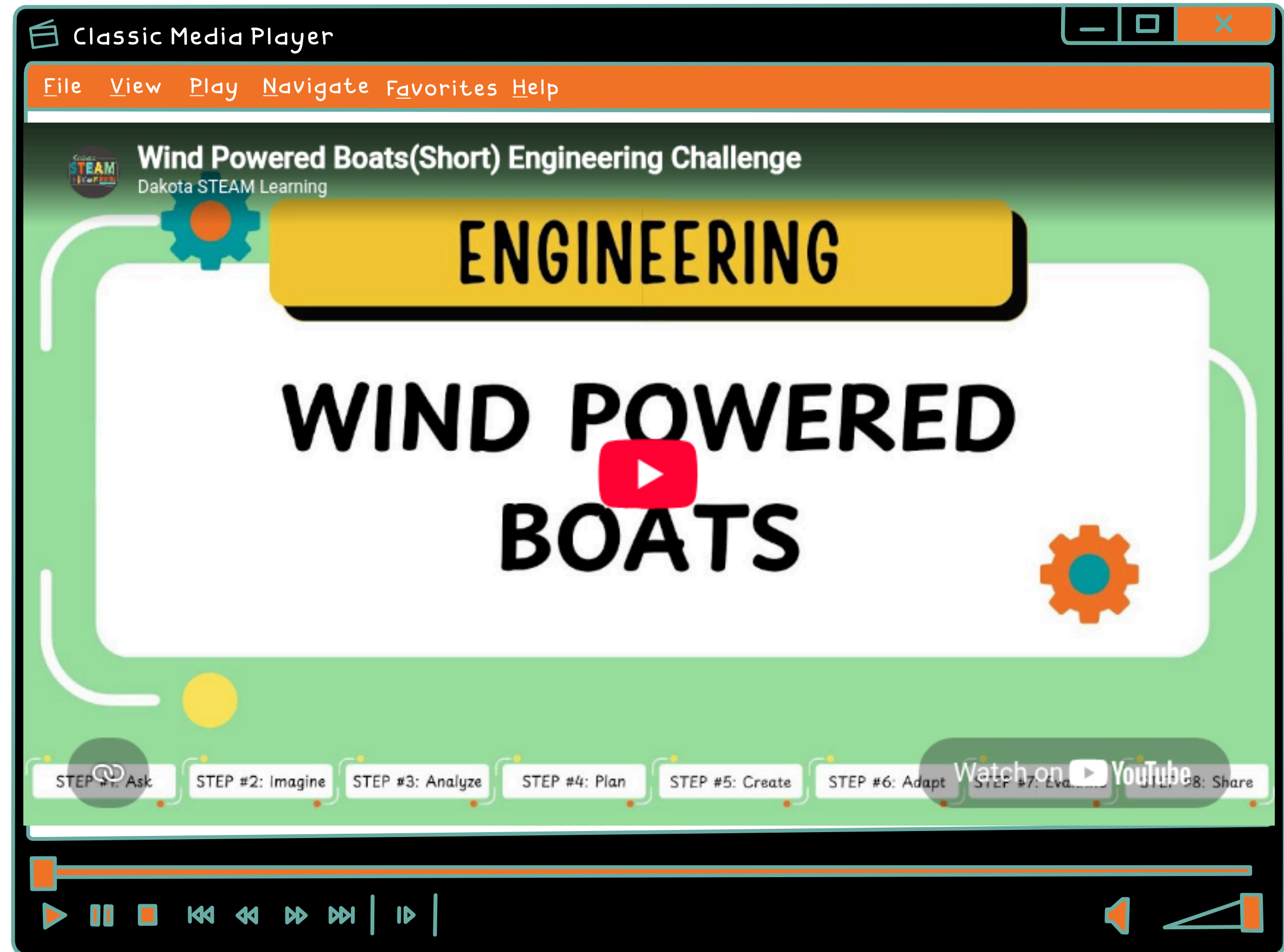
Students 1st make a small creation individually.

Students use this knowledge to make a larger version afterward. These are great for having students collaborate on the larger versions.

Typically take 3-5 hours.

FOLLOW ALONG

Click the play button to watch a follow-along video version of this guide.



Step #1: Ask

*Define our problem
and learn key
information*

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

Progress Bar

The bottom bar serves as a valuable visual aid for your students, helping them understand their progress within the STEAM steps and allowing them to connect it with their journals.

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share



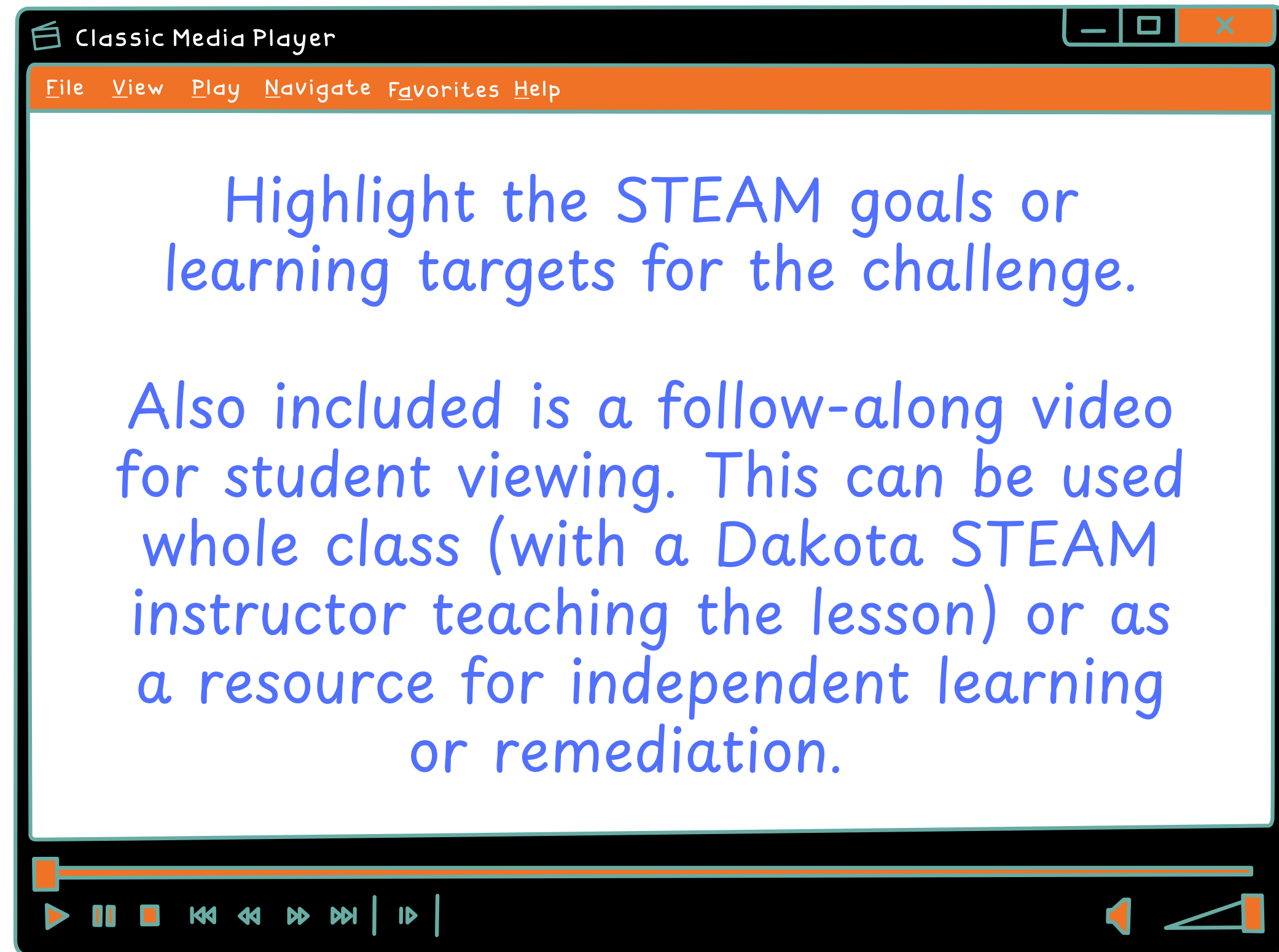
Today We Will...

ENGINEERING

Be presented with a big question and try and solve it.

Use our schema and new information to create prototypes that solve the problem.

Persevere when a challenge gets hard.

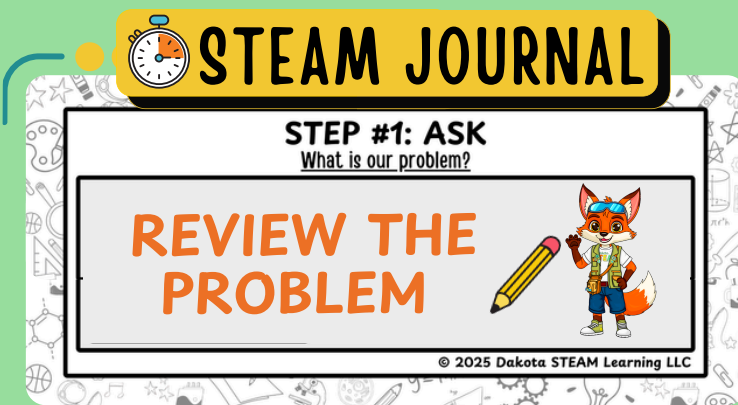


[Click here to watch a mini video for this lesson](#)

Problem

The problem they are being asked to solve is identified. It is presented as a question.

STEAM Journal to follow along with.



STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

Constraints or STEAM Rules

1. Constraints (limitations, etc.) are identified for students.
2. These are typically requirements that make the challenge more specific or difficult.
3. Highlight how much time students have to complete the challenge here.

Key Information

Criteria for Success

Criteria for success (what the students need to do) is identified.

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

STEAM Materials



ENGINEERING BASICS



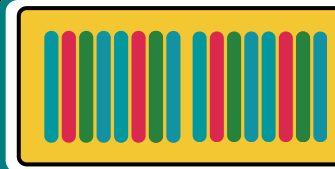
Pencil



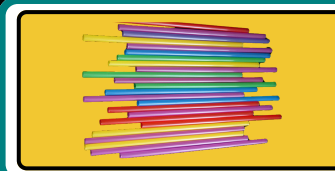
Tape



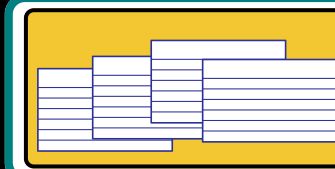
Scissors



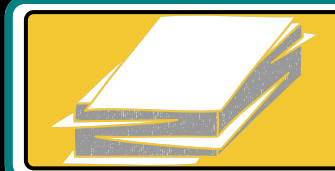
Popsicle
Sticks



Straws



Index
Cards



Cardstock
Paper



Cardboard

Testing Materials

Materials are identified for students. Note any limitations or additions for your specific students.

Remember
Tools, Not Toys!
Be Safe, Have Fun!

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

Step #2: Imagine

Use experiences and background knowledge to form initial ideas.

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

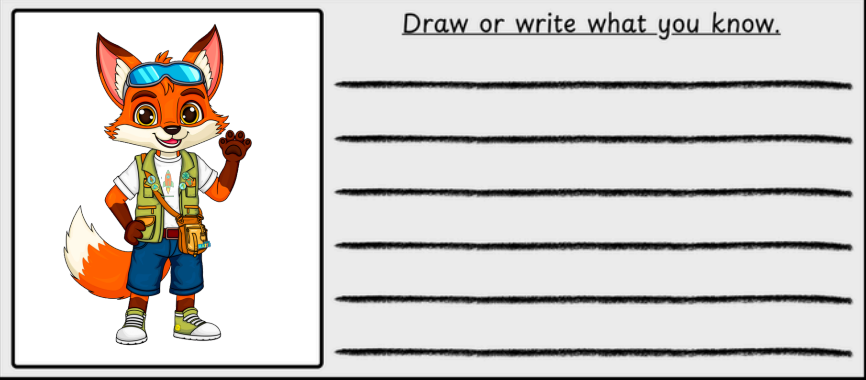
STEP #8: Share

Stop
students
and record
in STEAM
Journal

STEAM JOURNAL

STEP #2: IMAGINE
What do you know that could help you?

Draw or write what you know.



Activate Schema: Background Information

Questions designed to prompt students to consider relevant information related to the challenge are posed to initiate discussion.

You would then lead students through a discussion, pairs/small groups, and then a whole group, if possible. We recommend using your typical discussion structure.

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

Step #3: Analyze

Research relevant
topics to help form
new ideas

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share



STEAM RESEARCH :

We select key, relevant information to share with students. We include key facts and pictures to illustrate key points for students. Typically, multiple pages are included. These might relate to the science being studied, key building considerations, or inspiration for students' creation.

Example → DEN

Dens are secret hidden spots that animals use as their homes. Foxes, wolves, and bears are some examples of animals that live in dens.



STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share



RESEARCH RECAP :

This page provides a concise overview of the research to examine prior to creating a diagram.



STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

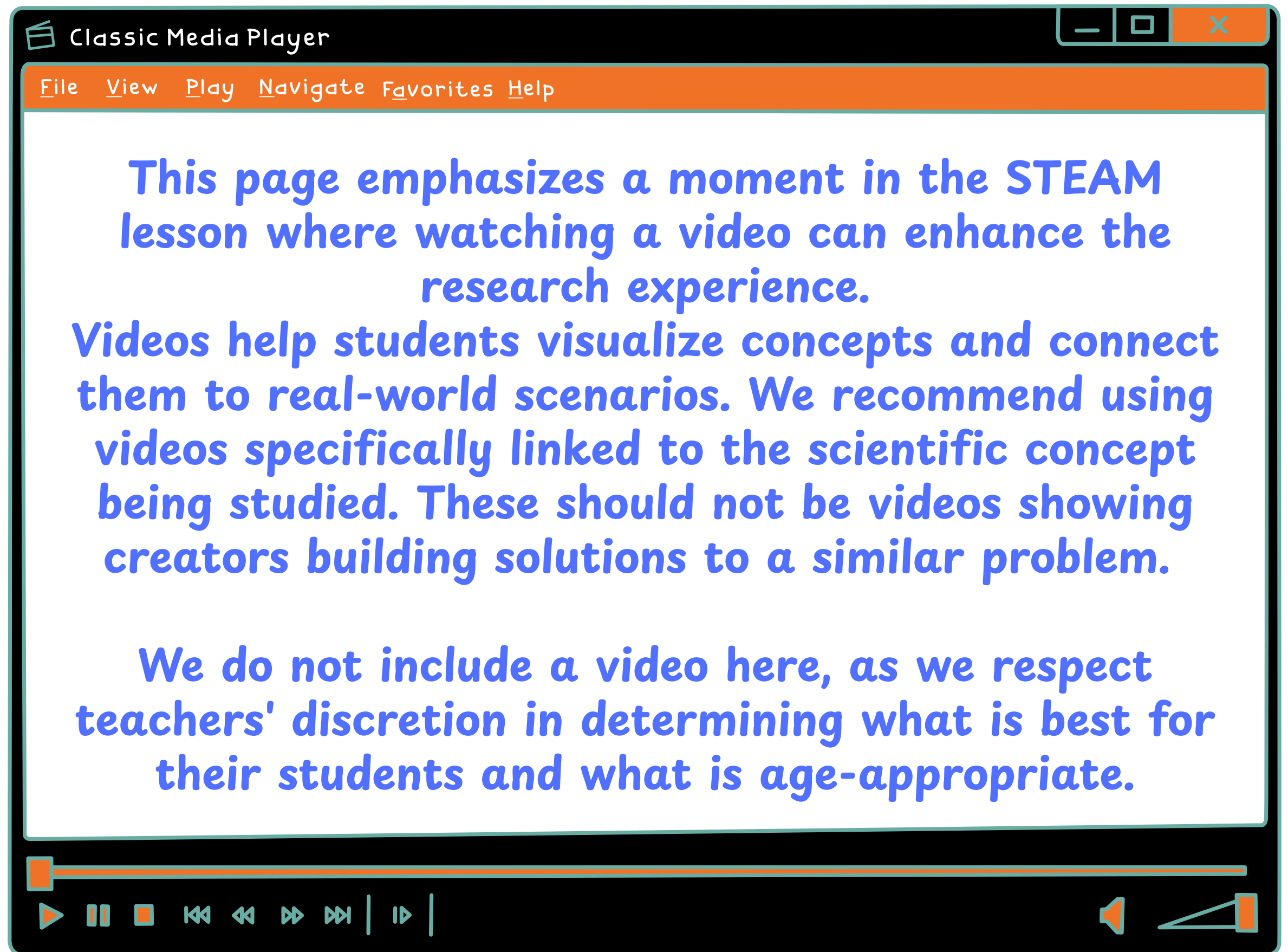
STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

STEAM RESEARCH

Optional:
Find a video to
learn more
about (research
topic).



STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

Stop
students
and
record in
STEAM
Journal

Time to Journal

STEP #3: ANALYZE
What is something new you learned from the research?

Draw or write what you learned.

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Add to your
STEAM Journal

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

Step #4: Plan

Make strategic decisions based on your knowledge to form an effective idea

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

How to Diagram

1 Brainstorm your idea.

Understanding Pictures vs. Diagrams

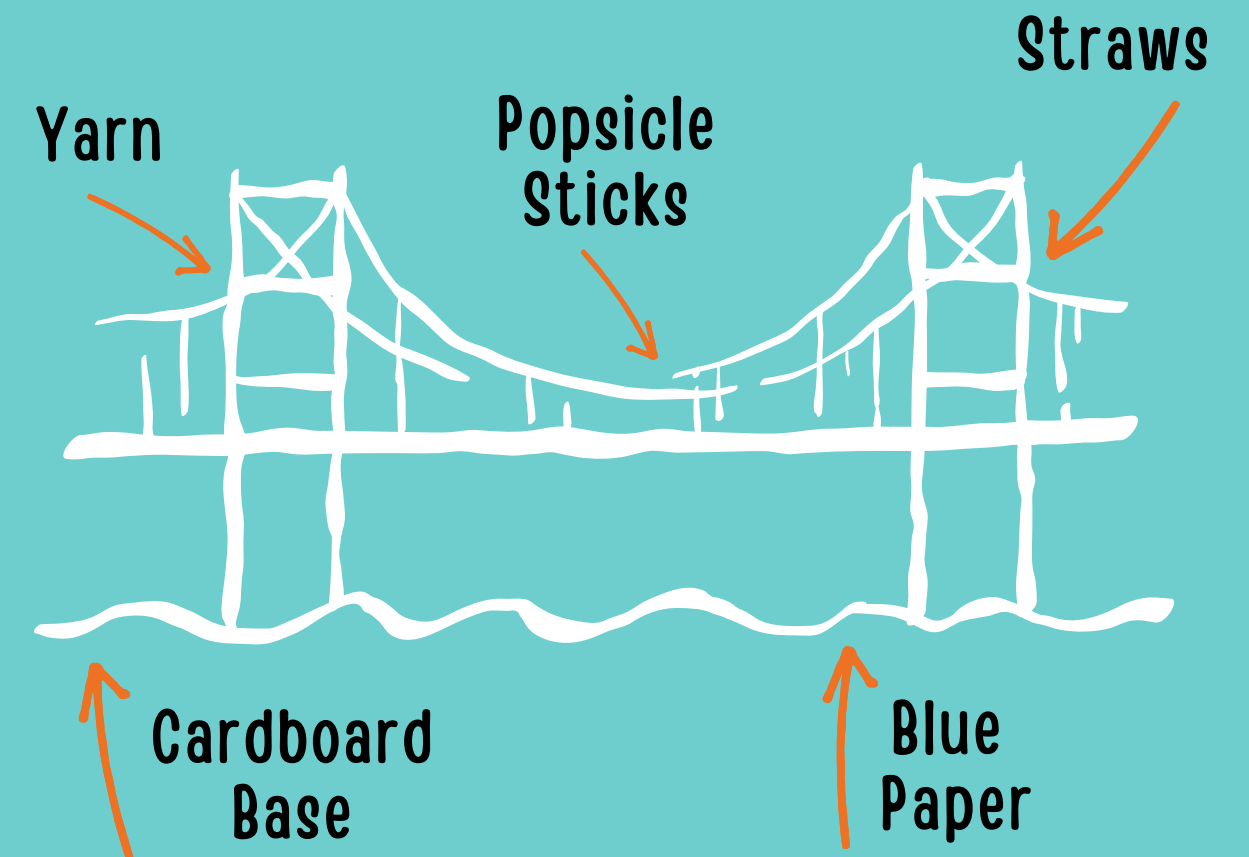
These slides help students distinguish between a picture and a diagram. They emphasize the expectations outlined in the STEAM journal and foster critical thinking skills. Remind students that their designs can evolve during the process; this is merely a starting point to guide their creativity!

2 Draw your idea.

Picture



3 Determine what materials each part of your creation will be made of.



Diagram

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

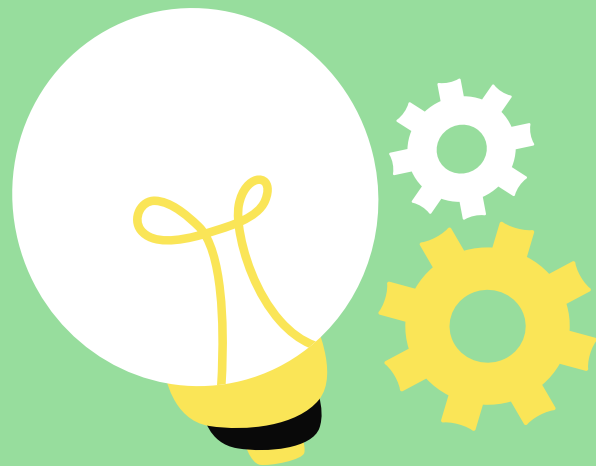
STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

How to Diagram

Brainstorm



1 Brainstorm your idea.

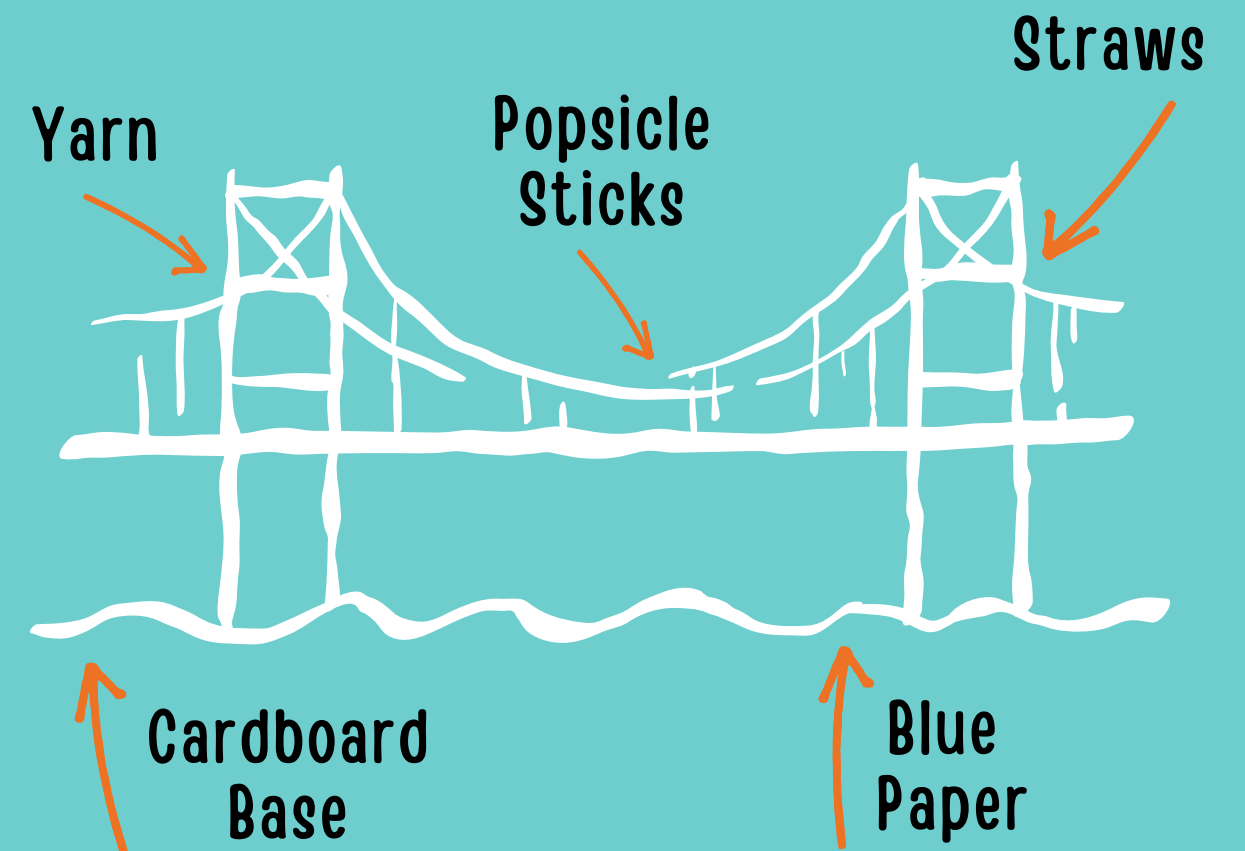
Picture



Pictures are pretty!
Diagrams help engineers determine the materials they'll use for different parts of their designs.

2 Draw your idea.

3 Determine what materials each part of your creation will be made of.



Diagram

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

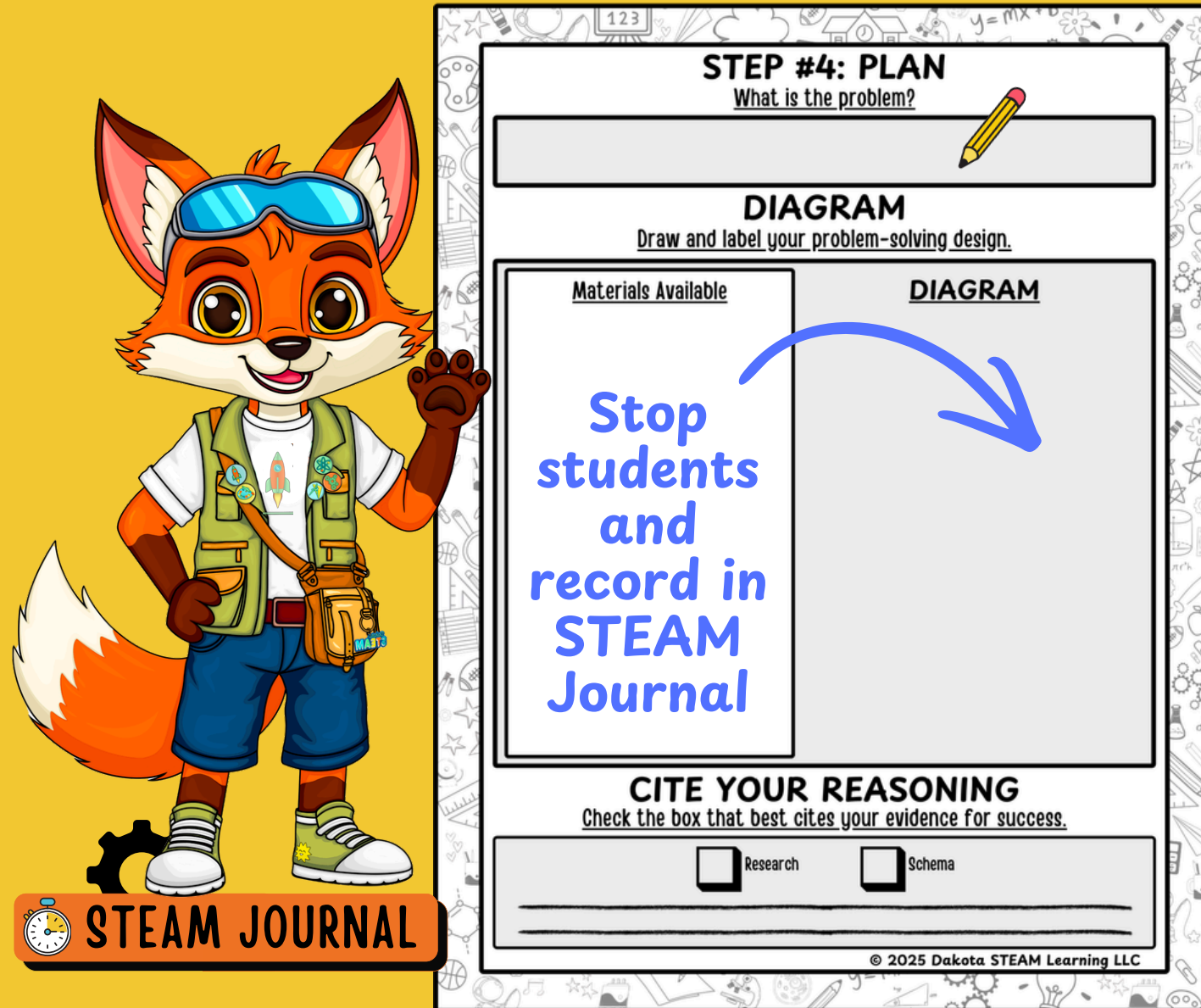
STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

DON'T FORGET to follow all of the constraints and meet the criteria for success.



Challenge Constraints

This slide helps students think back to the constraints when diagramming.

This will be a quick review, and the following slides will go more into detail about how to diagram.

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

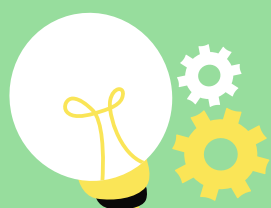
STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

1 Brainstorm your idea!

Brainstorm



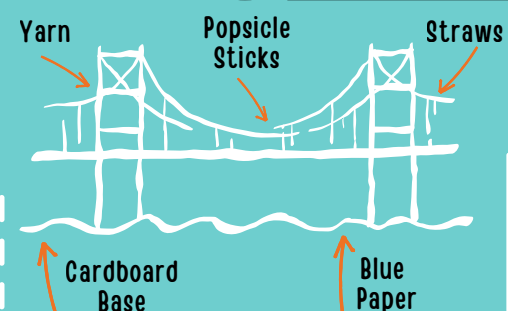
Pictures are pretty!
Diagrams help engineers determine the materials they'll use for different parts of their designs.

2 Draw your idea.

Picture

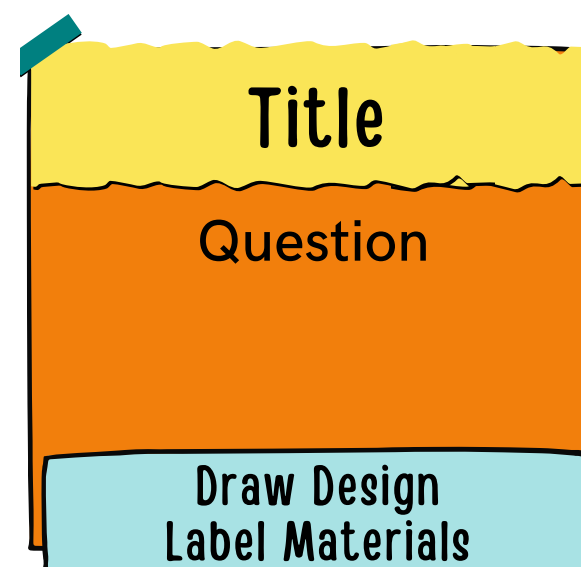


3 Identify what each part of your creation will be made out of.



Diagram

- This slide is designed to break the challenge down for students and help them succeed in planning.
- Relevant considerations are highlighted to prompt students' responses.
- These questions help them think about how their design will adhere to constraints and meet success criteria.
- Universal resources are embedded: how to diagram is reiterated, and how posts and beams must be utilized.



See Next Slide for Example

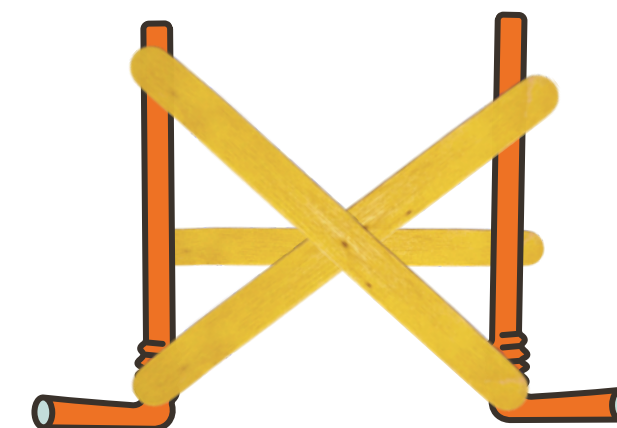


GUIDED DIAGRAM :

REMINDER

POSTS NEED BEAMS!

- ⚙ Posts stand upright.
- ⚙ Posts require beams to keep them stable and connected.
- ⚙ Every post should connect to two other posts.
- ⚙ Beams can be:
 - Across (horizontal)
 - Diagonal (high to low)
 - Double Diagonal (X-shaped)



STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

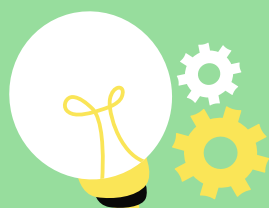
STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

1 Brainstorm your idea!

Brainstorm



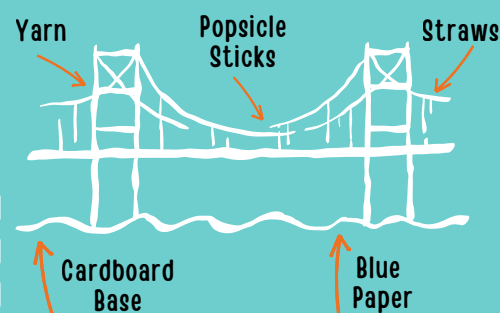
Pictures are pretty!
Diagrams are how engineers can identify what materials they will use for the different parts of their creation.

2 Draw your idea.

Picture



3 Identify what each part of your creation will be made out of.



Diagram



Shape

What shape will you use for the deck of your boat?

Draw Design
Label Materials



Floating

How will you keep water out of the boat?

Draw Design
Label Materials



Sail

How will you make sure your sail can move your boat? -size/way to inflate

Draw Design
Label Materials

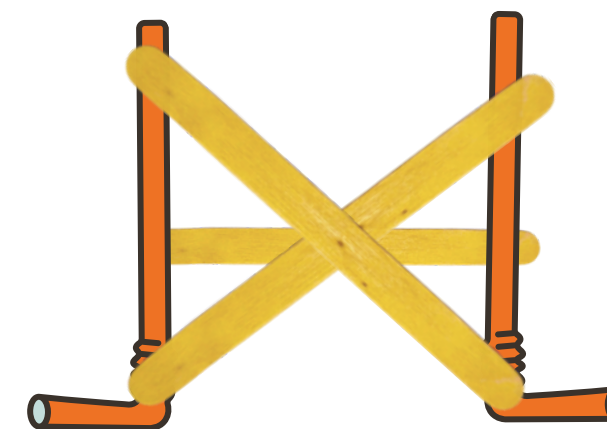


GUIDED DIAGRAM :

REMINDER

POSTS NEED BEAMS!

- ⚙ Posts stand up.
- ⚙ Posts need beams to keep them sturdy and connected.
- ⚙ Every post should be connected to 2 other posts.
- ⚙ Posts can be:
 - Across (horizontal)
 - Diagonal (high to low)
 - Double Diagonal (x shaped)



STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

SHARE IDEAS WITH OTHERS

1 Tell others your "What"

⚙️ The next slides support students in learning how to share their ideas, give feedback, and understand the STEAM expectations.

2 Tell others your "Why"

⚙️ Take as much time as you would like on the following slides. Skip if you have your own procedures in place.

SHARE IDEAS WITH OTHERS

1 Tell others your "What"

⚙️ What will your creation look like?

⚙️ What will each part be made of?

I will make my _____
by _____.

2 Tell others your "Why"

⚙️ Why do you think your idea will work?

- Based on your schema?
- Based on what we saw in the research?

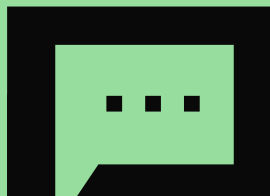
This should work
because_____.

GIVING HELPFUL FEEDBACK

Positive Feedback

Try: I think your idea will work well because_____.

Be specific! Focus on a specific aspect of their plan, like materials or structure.

Talk 

Negative Feedback

Try: I am concerned that_____ may not work because_____.

Be specific! Focus on a specific aspect of their plan, like materials or structure.

Talk 

AGREEMENTS

TRY

Do your best to help the other person.

TRY

Try not to make it personal by focusing on the idea instead of the person.

TRY

Try to speak kindly.

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

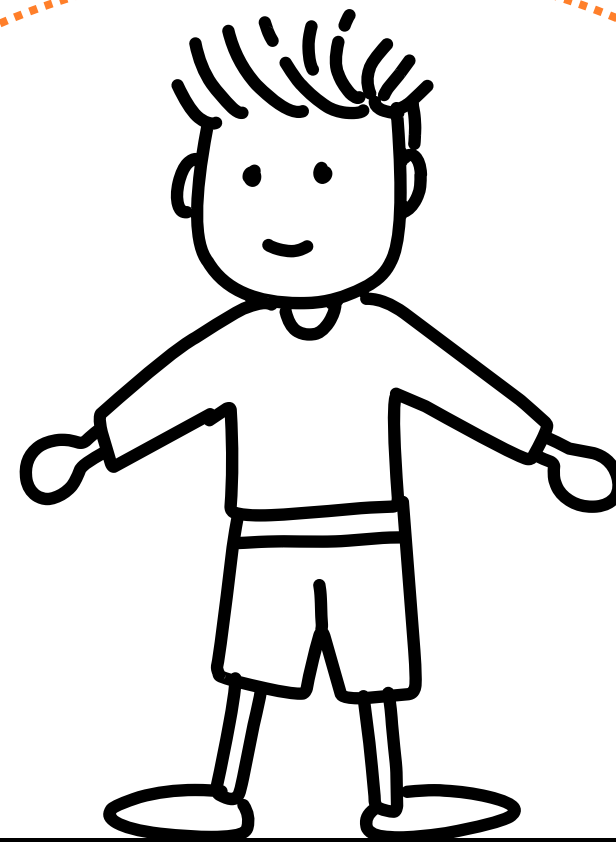
STEP #8: Share

FIGURINE CREATION

- Figurine templates are in the lesson plan.
- This slide helps students understand how to cut them out and use them in their STEAM project.
- We place this slide here because the figurine's size will help them determine the scale of their STEAM project.
- See the next slide for the example.
- Each STEAM challenge has a unique character associated with it.
- If a specialty figurine is being provided for students, it can be passed out at this time.

FIGURINE CREATION

Cut on the dotted
line.
Staple or tape the
stars together. This
helps it stand up!



Place your
name on the
strip or give
your figurine a
name!



STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

Step #5: Create

Use your resources to
make your creation

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

Step #5: Create

Step #5 is the stage where students gather all the necessary materials and information to tackle the challenge!

- The upcoming slides emphasize:
 - Engineering reminders and tips for successfully combining two or more materials.
 - Facilitators can utilize this slide to demonstrate how to approach the challenge effectively.
 - Check-ins are an excellent opportunity to remind participants about the constraints of the STEAM challenge and to inform them how much time remains to complete their work.

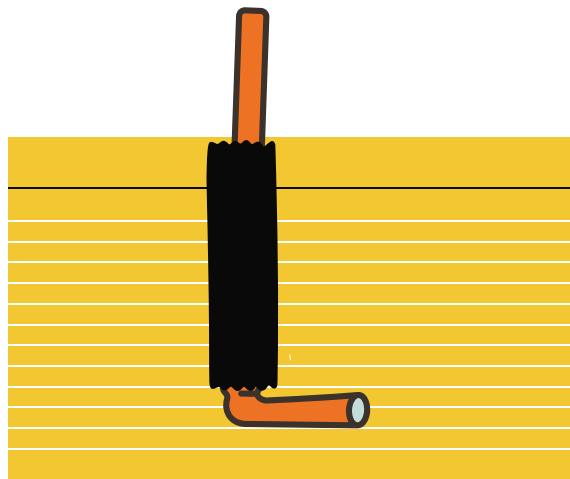


ENGINEERING REMINDERS

REMEMBER

KEEP JOINTS STRONG!

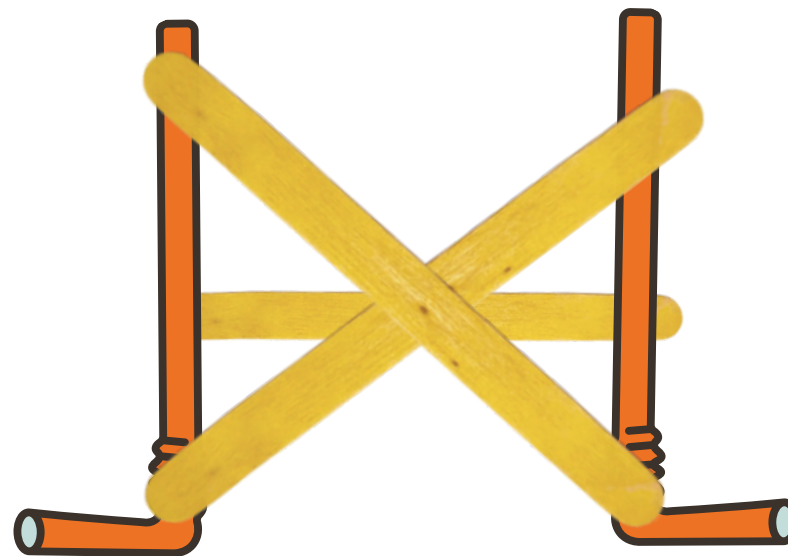
Joints happen where two materials meet. Tape along the joints, not just over them.



REMEMBER

POSTS NEED BEAMS!

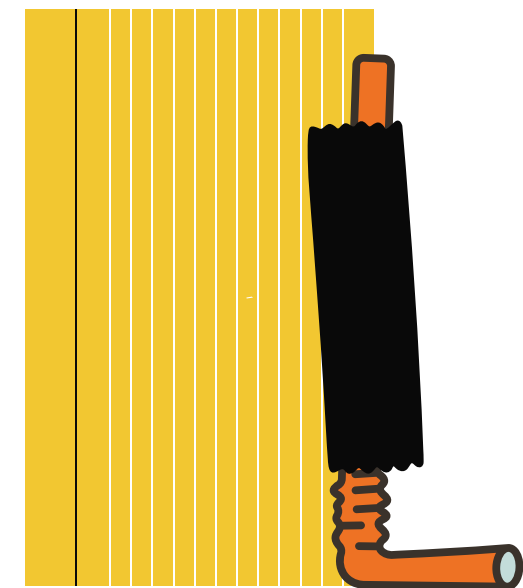
Posts stand upright. Beams are necessary to keep them stable and connected.



REMEMBER

MAKE CHANGES AS NEEDED!

These are just prototypes; adapt to challenges.



STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

How do you feel
about your
creation right
now?



Stop
students
and
record in
STEAM
Journal

CHECK IN

CHECK-IN #1

STEP #5: CREATE Check-ins

Check-in #1



Time



I'm doing great. I don't need help.



I'm doing okay. I could use a check-in.



I'm struggling. I could use some help.



Check-in #2

Time



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STEAM JOURNAL

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

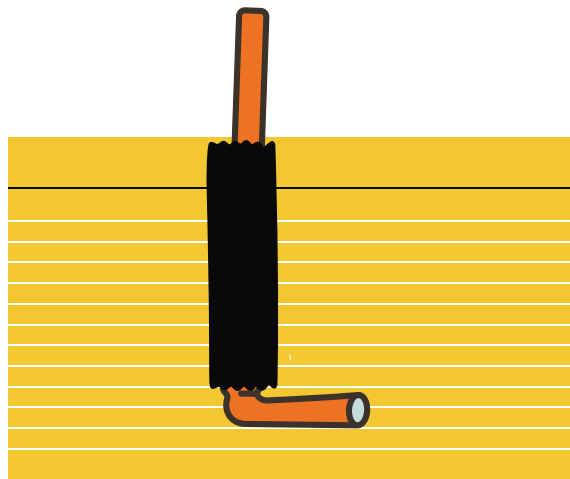


ENGINEERING REMINDERS

REMEMBER

KEEP JOINTS STRONG!

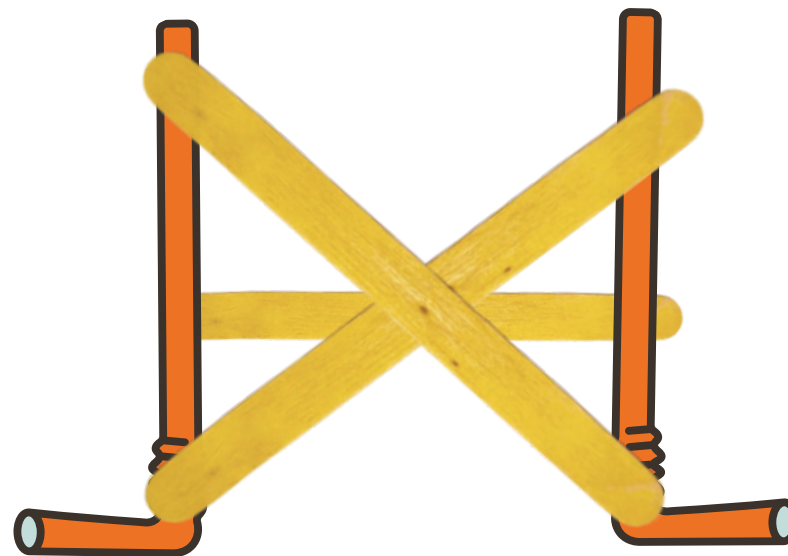
Joints happen where two materials meet. Tape along the joints, not just over them.



REMEMBER

POSTS NEED BEAMS!

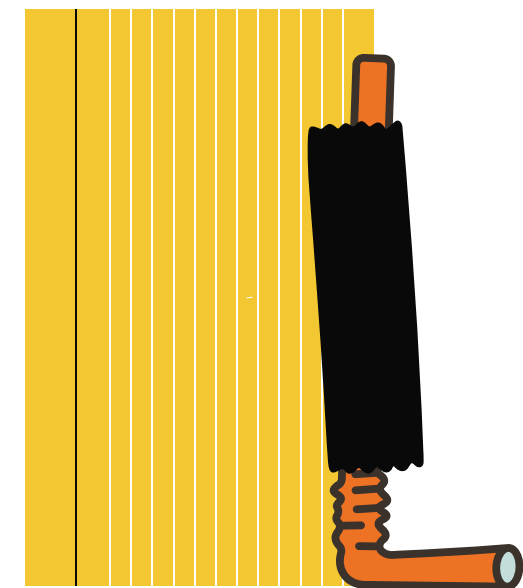
Posts stand upright. Beams are necessary to keep them stable and connected.



REMEMBER

MAKE CHANGES AS NEEDED!

These are just prototypes; adapt to challenges.



STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

How do you feel
about your
creation right
now?



Stop
students
and
record in
STEAM
Journal

CHECK IN

CHECK-IN #2

STEP #5: CREATE Check-ins

Check-in #1

Time



I'm doing great. I don't need help.



I'm doing okay. I could use a check-in.



I'm struggling. I could use some help.



Check-in #2

Time



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STEAM JOURNAL

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

STEP #6: Adapt

Use mini-tests to reflect and make changes as necessary to your creation

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

Mini-testing

For this challenge, we will mini-test to check the following:

This slide leads students through mini-evaluations of their creation. These are designed to share insight without ruining the creation. They will be prompted to check for:

- Criteria for success progress.
- Constraint adherence.
- Often, these are presented as questions to allow students to reflect on their failure points and prompt them to make necessary changes to their design.

We use mini-tests to find *failure points* and determine what needs to change before final testing. Then, during the final test, we can trust *that* our creation will be *successful*.

Stop students and record in STEAM Journal

STEP #6: ADAPT
Mini Test Results

Record the following:

1	Results ☐ Criteria Met ☐ Constraints Followed	Changes Needed
2	Results ☐ Criteria Met ☐ Constraints Followed	Changes Needed
3	Results ☐ Criteria Met ☐ Constraints Followed	Changes Needed
4	Results ☐ Criteria Met ☐ Constraints Followed	Changes Needed
5	Results ☐ Criteria Met ☐ Constraints Followed	Changes Needed

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STEAM JOURNAL



STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

Step #7: Evaluate

Make final improvements
to your creation and
conduct evaluations
to test final results

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share



FINAL TESTING TIME:

Steps To Setup Testing:

This orange box outlines how to prepare the students' creations for final testing.



STEAM JOURNAL

STEP #7: EVALUATE

Final Test Results

Check the box if the design met the requirement.

☐

Requirement 1

Totals:

☐

Requirement 2

Totals:

☐

Requirement 3

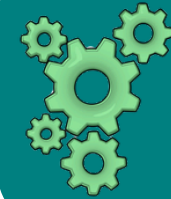
Totals:

☒

Requirement 4

Totals:

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Final Testing

Conduct Testing for Requirements - Check for the following:

Key testing information is identified to help test creations effectively.

- Steps for final testing:
 - Testing procedures are identified with emphasis on constraint adherence.
- STEAM Journal:
 - Have students record whether they met the challenge criteria.
- If the challenge is finished early:
 - Ideas for early finishers to do while the rest of the class is testing.

If you finish the challenge early:

1. Conduct a final round of mini-testing.
2. Go to the testing area and complete your final testing.

Then, you can:

1. Add decorative elements to your creation.
2. Help a friend at your table (only if they want help!).
3. Color your STEAM journal.



STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share



EXAMPLE

FINAL TESTING TIME:

Steps To Setup Testing:

Place your figurine inside of the boat and place your boat at the starting line.

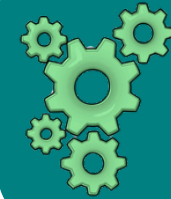
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STEP #7: EVALUATE
Final Test Results

Check the box if the design met the requirement.

☐	Requirement 1
Totals:	
☐	Requirement 2
Totals:	
☐	Requirement 3
Totals:	
☒	Requirement 4
Totals:	

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Final Testing With Water

Conduct Testing for Requirements - Check for the following:

1. Blow air at the boat, making sure not to hit the water with the air stream.
2. Boat must be able to travel from the starting line to the finish position.
3. Check that the figurine stays safely in the boat and does not get wet during testing.
4. Check that the boat stays floating and no water enters the boat while testing.

If you finish the challenge early:

1. Conduct a final round of mini-testing.
2. Go to the testing area and complete your final testing.

Then, you can:

1. Add decorative elements to your creation.
2. Help a friend at your table (only if they want help!).
3. Color your STEAM journal.



STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

Step #8: Share

Communicate
the effectiveness
of your design

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

Step #8 Slides

- Reflection
 - Can occur before or after you clean up from the engineering challenge.
 - Concludes the STEAM Journal
 - Students can share their reflections in a variety of ways: oral presentation, pair sharing, technological presentation or video, gallery walk, etc.
 - Set a procedure for their STEAM Journal at this time.





Sharing Reflections and Results

Important items to share:



Results

Describe how your creation performed during testing.

Reflect

Explain why you think your creation was effective or ineffective.

Surprises

*What surprised you the most while creating?
What did you learn?*



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STEP #8: SHARE

Final Test Results

What information do you want to share with others?

Draw or write down your information.

Stop
students
and
record in
STEAM
Journal



Results

Explain how your creation did when tested.



Reflect

Explain why you believe your creation was effective or ineffective.



Surprises

What surprised you the most when you were creating?
What did you learn?

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STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

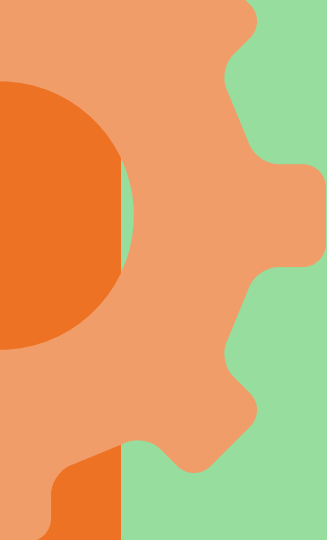
STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share



Thank you for creating
with us today!

This concludes today's
activity!

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Be sure to tag us in your projects!

STEP #1: Ask

STEP #2: Imagine

STEP #3: Analyze

STEP #4: Plan

STEP #5: Create

STEP #6: Adapt

STEP #7: Evaluate

STEP #8: Share

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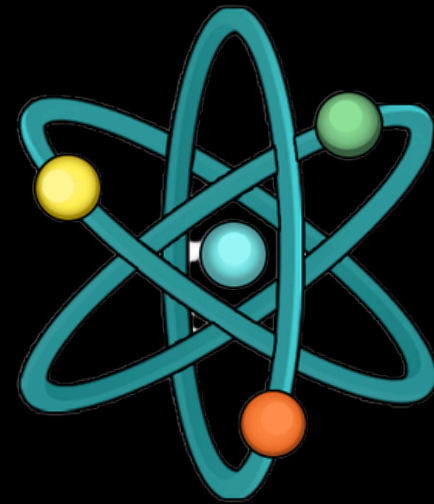
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